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Brillouin light scattering and second harmonic generation of strontium barium niobate crystals

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Brillouin light scattering and generation of the second optical harmonic (SHG) are investigated in the 115–850 K temperature range in a series of $Sr_xBa_{1-x}Nb_2O_6$ (SBN-x) crystals of various chemical compositions (x = 0.3, 0.5, 0.6, 0.75) which exhibit the properties of both an conventional ferroelectric (x = 0.3, 0.5), and relaxors (x = 0.6, 0.75). The aim of this research is investigation of local noncentrosimmetric inhomogenities in the paraelectric phase in ferroelectric crystals [1].

SHG signal was recorded in TriVista 777 spectrometer with a spectral resolution better than 1 cm^{-1}. It is shown that the integral intensity of the second harmonic signal follows the Arrhenius law with an activation energies of ΔU= 0.09– 0.3 eV. The second harmonic generation is observed in paraelectric phase of the SBN-x crystals, revealing the presence of local asymmetric regions in the volume. The spectral width of the SHG spectrum does not exceed 0.3 cm^{-1} and is temperature independent. Upper limit of the spectral width of the SHG spectrum provides lower limit of the lifetimes of polar regions, which are longer than 15 ps. It suggests that the doubled frequency signal in the paraelectric phase of the SBN-*x* crystals is generated in areas with lifetimes longer than 15 ps. Acoustic properties of the samples were investigated in a Brillouin light scattering experiment in a six-pass Fabry–Perot interferometer with a spectral resolution about 1 GHz. It is shown that local polar regions cannot explain the anomalies of the elastic module near the ferroelectric phase transition in SBN-*x*.

1. G. Burns, B.A. Scott, *Solid State Comm.* **13**, 423 (1973).